SCIENCE

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FRIDAY, MAY 26, 1905.

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THE GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY.

THE annual general meeting of the American Philosophical Society was held this year during Wednesday, Thursday and Friday of the second week in April. The sessions as usual were held in the rooms of the society in Philadelphia. The number in attendance, including non-resident members, resident members and others, was quite as large as on previous similar occasions, while the quantity and character of the papers offered, together with the discussion on them, called forth much favorable comment. The program was especially broad in its scope, including the various departments of natural and physical science, of literature and of problems in economics.

On Thursday the society sent, through its secretary, Dr. I. Minis Hays, a telegram of greeting to the University of Virginia on the occasion of the inauguration of a president of its faculty. This was done in special commemoration of the fact that Thomas Jefferson, the founder of the university, was also an early president of the American Philosophical Society.

The meeting was opened on Wednesday afternoon at 2:30 o'clock by the president, Vice-Provost Edgar F. Smith, of the University of Pennsylvania, with a brief address of welcome, after which the following papers were presented:

The Weal-Relation: Professor LINDLEY M. KEASBEY, of Bryn Mawr, Pa.

A Plea for Governmental Supervision of Posts Necessitating Normal Perception of Color: Dr. Charles A. Oliver, of Philadelphia.

The Present Status of the International Catalogue of Scientific Literature: Dr. Cyrus Adler, of Washington.

The Composite Character of the Babylonian Creation Story: Professor Morris Jastrow, Jr., of Philadelphia.

In the course of his address on 'The Composite Character of the Babylonian Creation Story,' Professor Jastrow referred to the progress made in recent years in the interpretation of the Babylonian creation tale, thanks chiefly to the discovery of new fragments of the story in the remains of the famous Assyrian library of Ashurbanapol, at Nineveh.

"We now know," he said, "that the narrative in the form of a poem consisted of about 1,000 lines, of which three fourths have been found. The version of the story which we have is the one that was produced in the city of Babylon by the priests of Marduk, the chief god of the later Babylonian Pantheon. This god is, therefore, introduced as the creator and as playing the principal part in the struggle between the gods and an army of monsters led by Tiamar.

"The 'Babylon' version of the creation story rests on an older tale, which originated in Nippur, and in which the chief god of that city, who was called Bel, is the hero. When the 'temple library' of Nippur shall be discovered, or if it has been discovered, we may expect to find this older version. At present we may conclude from the 'Babylon' version that an earlier 'Nippur' version existed. There was, however, also a third version, which originated in Eridu, one of the most ancient religious centers of Babylonia, and in which the god Ea played the chief rôle.

"In the 'Babylon' version the two older versions, that of Nippur and that of Eridu, have been combined to form the Marduk epic. Bel's name and rôle are transferred to Marduk, and, likewise, Ea's prerogatives. A trace of the three versions is to be seen in the opening lines, which designate three beings, all synonyms of one another, as the symbol of the water chaos which preceded the organization of the regular workings of nature."

The English Masque: Professor Felix E. Schelling, of Philadelphia.

The English masque is a by-form of the English drama which flourished between the years 1597 and 1658, and is absolutely definite in its nature and characteristics, and to be defined as that species of the entertainment, the nucleus of which is a dance. The masque was usually presented at court as the setting of a ball and the actors in its serious parts were the nobles and ladies attendant on royalty. The masque is based on the revels, disguisings and maskings popular in England and, especially at court, from time immemorial. It is in no wise a derivative in any essential feature of similar festivities of Italy or France; but was developed as a definite product of literary and histrionic art chiefly in the reigns of King James and King Charles I. Thomas Campion, the musician, and Samuel Daniel, the court poet, wrote its earliest forms; but it was perfected mainly in the hands of Ben Jonson, who added the antimasque, or contrasted comedy element; while Inigo Jones, the royal architect, brought its costuming, scenic features and mechanical devices for stage effect to a surprising degree of perfection. The list of less than sixty masques within this period is surrounded by many dramatic compositions of a character more or less similar. But even Milton's Comus,

commonly designated a masque, is not, strictly speaking, such a production.

The distinguishing features of the masque were its allegorical presentation of matter supposedly fitting to the occasion; its lyrical poetry; its novel musical effects and combinations both vocal and instrumental, the gorgeousness and costly quality of its costuming; the ingenuity of its stage settings and mechanical devices for stage effect; its mingling in one performance, though in separate parts, the amateur with the professional actor; and scenes of comic relief offered in the antimasque performed by professional singers, dancers and players.

The Emancipation of the Waterways: Professor LEWIS M. HAUPT, of Philadelphia.

In his paper on the 'Emancipation of the Waterways,' Professor L. M. Haupt traced first the beneficial effects of improvements in the capacity of navigable channels in lowering the rates of freight, as for grain from Chicago to New York from 29.6 cents per bushel in 1866 to 4.7 cents in 1903, due to the enlargement of the Soo canal from 12 to 20 feet. He quoted Senator Frye to the effect that the saving on lake freights in one year was five times the total cost of the entire lake system, and estimated that the saving on the tonnage of 1903 was $194,660,408. He then showed the increased value to result to the western farmer by the proximity of navigable channels as illustrated in the lower prices received in Nebraska, Kansas and Missouri as compared with states nearer the seaboard, and that this difference was the cost of the overland haul. On cereals alone this charge amounted to a loss to Nebraska of over $14,000,000 as compared with prices in Kansas, a little nearer water rates. The policy of European countries owning railways was then stated to be a return to the rapid and extensive development of their canal systems to encourage the delivery of raw materials for manufactures in the competition for the world's markets as in France, Belgium, Holland, Germany, Russia, Austria, Italy, etc., where thousands of miles are under construction with improved hydraulic and electric lifts and with electric haulage, for barges of from 300 to 1,000 tons.

The decadence of and opposition to the canals in this country are shown in the abandonment of over 700 miles in Pennsylvania; 656 in Ohio; 269 in New York, etc.; and the effort now on foot in the latter state to prevent the enlargement of the Erie to even 12 feet, so as to retain some of the grain trade which must otherwise go to Canadian ports.

The great profit-earning capacity of canals under corporate control was shown in the case of the English and American canals which have been maintained, as compared with those managed by railways, which was stated to be due to the small cost of operation.

In 1835 there were 2,700 miles of canals in operation in the United States, but by 1889 it had fallen to 2,305 miles, while the railroads had increased in the same time from 1,000 to 158,000 miles, and were still opposing waterway legislation, although it was believed, in the speaker's opinion, to be the most beneficial auxiliary to the development of railway revenues, as shown by the stock quotations of the roads having deep-water competition.

The great pressure upon Congress, the shortness of the sessions and the enormous demands for enabling legislation which have been accumulating for years, in some cases more than a half century, lead to the conclusion that much more satisfactory results could be secured for the emancipation of our waterways by a return to the early policy under which they were developed by

private or state control, locally, with powers to exercise the rights of eminent domain as is still done in the case of highways and railroads.

The Beginnings of Lumbering as an Industry in the New World: Mr. JOHN E. HOBBS, of North Berwick, Me.

THURSDAY, APRIL 31.

Morning Session—10:30 O'clock.

President Smith in the chair.

The Structure of the Lignified Cell Wall: Professor JOHN M. MACFARLANE, of Lansdowne, Pa.

The lignified cell wall has been regarded as built up of a series of lamellæ deposited from without inward on the primary cellulose membrane, all of the lamellæ being in direct contact with each other. The stratified appearance has been explained by Hanstein, Strasburger and others as due to 'water-poor' and 'water-rich' layers.

From a study of numerous types of indurated element drawn from many of the vascular plants, the speaker stated that he regarded the lamellæ as quite distinct from each other, and separated by spaces usually as wide as the lamellæ themselves. The aniline sulphate and phloroglucin reactions clearly showed the lignin lamellæ colored, while the cavities or inter-lamellæ were unaltered. Aniline stains that act on lignified walls, such as safranin and aniline purple colored the lamellæ deeply and left the inter-lamellæ unstained. By appropriate protoplasmic stains, the inter-lamellæ were found to contain diffuse protoplasmic material in connection with the intercellular protoplasmic threads that penetrated the pores of the cell walls. The lamellæ were held in connection by fine lignin processes that stretched from lamella to lamella. The number of distinct lamellæ might vary from two to ten in the ordinary sap-conducting xylem tracheids and the fibrous sheath cells of the monocotyledonous bundle, to as many as from sixty to seventy in the indurated cells from the cortex of different plants.

That the lignified wall is built up of distinct lamellæ that alternate with interlamellar cavities containing protoplasm, gives a new conception as to the pathway for the ascending crude sap current and for the distribution of nutritive liquids through the tissues of the plants. It also furnishes valuable data for building up a correct conception of the minute structure of plant tissues, alike from the standpoint of intercellular protoplasmic continuity and of cell wall growth.

New Species of Genus Nepenthes: Professor JOHN M. MACFARLANE, of Lansdowne, Pa.

Five new species of pitcher plant were fully described or referred to in connection with his recent studies. These included *N. Beccariana* and *N. neglecta,* both obtained from the herbarium of Professor Beccari, of Florence; *N. Hemsleyana,* identified as a new species from specimens collected during the Burbidge and Veitch Expedition to North Borneo; *N. Copelandi,* determined and named by Dr. Merrill, head of the Botanical Survey of the Philippine Islands, and *N. Macfarlanei,* a species named by Mr. Hemsley, curator of the herbarium at Kew, from material discovered by the speaker in Kew Herbarium.

On Thought Transference Among Animals by Touch and Scent: Mr. ALDEN SAMPSON, of Haverford.

Mosaic Development in Ascidian Eggs: Professor EDWIN G. CONKLIN, of Philadelphia.

The Oligodynamic Action of Copper Foil on Certain Intestinal Organisms: HENRY KRAEMER.

The classical experiments conducted by Nägeli during the eighties for determining the toxicity of solutions of copper produced by placing clean copper coins in distilled water for several days, on *Spirogyra*, a filamentous alga, was reviewed.

It was pointed out that Nägeli observed that the effects produced by the copper solution so obtained, on *Spirogyra*, differed from those due to ordinary chemical poisoning, and that in describing the supposedly distinctive effects of such minute traces of copper in solution (he having estimated that approximately 1.3 parts of copper to 1,000 million parts of water would kill *Spirogyra*), he used the term 'oligodynamische,' meaning thereby the force or action exerted by a small quantity of substance.

Reference was made to the very great importance of Nägeli's discovery from a scientific point of view, and the statement made that while researches of the kind conducted by Nägeli and other writers since his time had an important bearing on pharmacology, it was not, however, until the publication of the bulletin on 'A Method of Destroying or Preventing the Growth of Algæ and Certain Pathogenic Bacteria in Water Supplies,' by Moore and Kellerman nearly a year ago, that the very great practical significance of work along these lines became apparent and general interest was aroused in the subject.

Since last fall the author has carried on a number of series of experiments with the particular end in view of testing the efficiency of metallic copper for destroying typhoid and colon bacilli. The technique was described, and the following conclusions drawn from the results obtained as well as those given by other writers:

1. Certain intestinal bacteria, like colon and typhoid, are completely destroyed by placing clean copper foil in water containing them, or by adding the organisms to water previously in contact with the foil.

2. The toxicity of water to which either copper coins or copper foil has been added is probably due to the solution of some salt of copper, as first suggested by Nägeli.

3. The copper is probably in the form of a crystalloid rather than that of a colloid, as it has the property of permeating the cell walls and organized cell-contents of both animals and plants, thereby producing the toxic effects.

4. While the effects produced by the oligodynamic action of copper are apparently different from those of true chemical poisoning, the difference is probably in degree only and not in kind.

5. Certain lower organisms, including both plants and animals, possess a specific sensitiveness to minute quantities of copper and other substances as well, and it has been shown that they are not restored on transferring them to water free from oligodynamic properties.

6. Oligodynamic solutions of copper are obtained by adding copper coins, copper foil, or salts of copper to water. When copper foil is allowed to remain in distilled water from one to five minutes sufficient copper is dissolved by the water to kill typhoid organisms within two hours.

7. A solution of copper may lose its toxicity by the precipitation of the copper as an insoluble salt or compound, by its absorption by organic substances, or by adsorption by insoluble substances.

8. The oligodynamic action of the copper is dependent upon temperature as first pointed out by Israel and Klingmann.

9. The effects of oligodynamic copper in the purification of drinking water are in a quantitative sense much like those of filtration, only the organisms removed, like *B. typhi* and *B. coli*, are completely destroyed.

Observations on Columbium and Tantalum: Dr. EDGAR F. SMITH.

No difficulty was experienced in separating these elements. It was found that tantalum formed two or more double salts with the fluoride of each of the alkali metals. It was further shown that by virtue of this fact the double fluorides were not to be regarded as suitable material with which to determine the atomic weight of tantalum. Similar work was being done with columbium. The latter has not yet been freed absolutely from titanium, although certain methods being used at present promise well.

Tantalic and columbic oxides are both volatile in a current of carbon tetrachloride, the first yielding tantalum pentachloride and the second columbium oxychloride.

The Effects on Metabolism of Preservatives Added to Foods: H. W. Wiley, M.D., of Washington.

During the past three years we have studied in the Bureau of Chemistry in the Department of Agriculture, the various effects produced upon health and digestion by the addition of preservatives to food products. The substances which have been studied are boric acid, borax, salicylic acid, salicates, sulphurous acid, sulphite, benzoic acid, benzoates, formaldehyde and copper sulphate. The medical effects of all these bodies were carefully observed and recorded. The effects on metabolism were studied by weighing and analyzing the foods received, and collecting and analyzing the excreta of those under observation. The number of persons under observation has, in all cases, been twelve, except where accidental illness has diminished the attendance at the table. The effects produced upon the balance show the total quantity of any element ingested in the food and the amount recovered in the excreta. The research embraced protein, phosphoric acid, sulphuric acid, carbohydrates and fats. Only the data for boric acid and borax have been published. The other data are in course of preparation.

The general effect of borax and boric acid is: (1) To diminish or tend to diminish the weight of the body; (2) to diminish the avidity of the appetite; (3) a tendency to diminish the per cent. of nitrogen excreted, which, slightly marked in the preservative period, was even more marked in the after period, showing an accumulative effect in this direction; (4) the development of a tendency to increase the excretion of phosphorus. All the data taken together show that 97.3 per cent. of the phosphorus digested in the food was recovered during the fore period, 103.1 per cent. during the borax period, and 97 per cent. during the after period; (5) a tendency to increase, to a slight extent, the combustion of fat in the food; (6) a tendency to slightly diminish the total calories obtained from the food; and (7) a tendency to increase the quantity of solids in the food eliminated in the feces. This condition is easily explained in the tendency established during the exhibition of the preservative to slightly derange the digestive functions. The data also show that nearly 80 per cent. of the total borax and boric acid ingested in the food are excreted in the urine and the rest, apparently, through the skin.

The general result shows a greater or less derangement of metabolic processes of a character tending to injure the health.

Electroanalysis with a Rotating Anode and Mercury Cathode: Lily G. Kollock and Dr. Edgar F. Smith, of Philadelphia.

A number of metals may be rapidly precipitated in this way. The quantity of metal deposited in from four to seven minutes varies from a quarter to more than one half gram. The use of the mercury as cathode does away with a platinum dish

or cone and greatly reduces the expense incurred in general electrolytic work. The metals studied were cadmium, zinc, iron, nickel, copper, cobalt and bismuth.

Afternoon Session—2:30 O'clock.

Vice-President Scott in the chair.

The Rounded Sands of Paleozoic Formations: GILBERT VAN INGEN, Princeton, N. J.

Certain sandstones and dolomites of Paleozoic age contain well-rounded grains of detrital quartz having the mat surface peculiar to sand which has been rounded during transportation by wind. Some of these sandstones are considered by the author to be of desert origin, others to represent fossil barrier bars and spits, still others dunes. The sand of the dolomites is believed to owe its presence in those marine rocks either to flotation from a barrier bar or spit or to transportation by wind from a desert or dune-covered shore. The evidence of these sand grains on paleogeographic conditions is briefly discussed.

A Review of Lacroix's Work on the Montagne Pelée (with lantern illustrations): Professor ANGELO HEILPRIN.

The Mammalian Fauna of the Fort Union Beds: Mr. M. S. FARR.

The Marsupial Fauna of the Santa Cruz Beds: WM. J. SINCLAIR, Princeton, N. J.

The paper presents some of the more important results of a study of the marsupials of the Santa Cruz formation of Patagonia, which will be treated monographically in the forthcoming Volume VII. of the reports of the 'Princeton University Expeditions to Patagonia.'

The large Santa Cruz carnivores are shown to be true marsupials, belonging to the same family as the Tasmanian wolf *Thylacinus*. The suborder Sparassodonta is proved to have been based on a mistaken assumption. Certain small forms comparable in size to the South American opossums are included in the family Didelphyidæ, but are not regarded as prototypal to any of the existing opossums. A new family is proposed for reception of the Santa Cruz diprotodonts, the most primitive members of which are shown to be transitional to the Polyprotodontia. The descent from common ancestors of certain Australian, Tasmanian and South American types is suggested, and its bearing on paleogeography briefly discussed.

The Mutual Affinities of the Species of the Genus Cambarus: A. E. ORTMANN, of Pittsburg.

The Faunal Relations of the Ryu-kyu (Loo Choo) Islands: Dr. HENRY A. PILSBREY.

Evening Session—8 O'clock.

At the Free Museum of Science and Art, University of Pennsylvania, President Smith in the chair.

Reason and Intelligence vs. Custom and Habit in the Nutrition of the Body (illustrated by lantern slides): PROFESSOR RUSSELL H. CHITTENDEN.

A reception was given at nine o'clock in the museum by the president and council to the members of the society and the ladies accompanying them.

FRIDAY, APRIL 14.

Morning Session—10:30 O'clock.

Vice-President Newcomb in the chair.

The Secular Perturbations of the Earth: MR. ERIC DOOLITTLE.

It is well known that the earth and all of the other planets move about the sun in almost circular curves called ellipses. But the size and shape of the path in which any one planet moves are constantly changing

on account of the disturbing pull of all of the other planets. In order to predict the position of any planet, or of the sun for use in surveying and navigation, at any future time, these minute changes in the form and position of the orbits must be rigorously calculated and allowed for. One method of doing this is by obtaining any variation in the form of an infinite series, and then adding together as many terms of this series as are thought to be necessary. The computations in the great work of Le Verrier and Newcomb were performed in this way.

The German mathematician, Gauss, has proved, however, that those variations of the orbit of any body which increase indefinitely with the time will be precisely the same as the variations produced, not by the pull of the other planets, but by the pull of a series of elliptic rings which respectively coincide with the orbits of these disturbing planets. The mathematical computation of the effect of the pull of these rings on the orbit of the disturbed planet leads to a definite integral instead of to an infinite series.

The present paper gives the results of this computation as applied to the orbit of the earth. It is part of a work on which the author is engaged, which, when completed, will give the computation for each of the four inner planets.

On the Problem of Four Bodies: Professor Edgar Odell Lovett, of Princeton.

Radio-Activity in Solar Phenomena: Professor Monroe B. Snyder, of Philadelphia.

Evidence Relating to Latitude Variations of Short Periods. From Observations at the Flower Observatory During the Year 1904: Professor C. L. Doolittle, of Philadelphia.

Enquiry into the Pressure and Rainfall Conditions of the Trades-Monsoon Area: W. L. Dallas, of the Meteorological Office, India. (Presented by Professor Abbe.)

Mr. W. L. Dallas, who has been prominent for twenty years past as the first assistant in the office of the 'Meteorological Reporter to the Government of India' communicated 'An Enquiry into the Pressure and Rainfall Conditions of the Trades-Monsoon Area.' This is a contribution to the great problem of predicting the character of the approaching crop season and the crop itself. In India the crop depends on the rains of the southwest monsoon. After they have ended the crop ripens and the harvest comes before the dry season is under way. Formerly we thought of the southwest monsoon as a northeast trade-wind from the north Indian Ocean diverted toward the warm interior of Asia and the slopes of the Himalayas. But the Indian meteorologists, by studying the reports of winds from the Indian Ocean have succeeded in demonstrating that the southwest monsoon comes across the equator and is with the southeast trade-wind of the southern Indian Ocean drawn towards India and Siam and China. The intensity and direction depend upon the distribution of barometric pressure from the Himalayas, south to Cape of Good Hope on the west and to Australia on the east. In fact, the great area of land that we divide up into three continents of Europe, Asia, Africa, act as one warm area, the great dry land hemisphere, to disturb the action of the great water hemisphere. The dry land and the aqueous hemispheres of our globe by their annual warming and cooling powerfully affect the general circulation of the atmosphere, transforming it into an attempt at a huge whirl around the continent in opposite directions in summer and winter.

In this transformation a large fraction of our whole atmosphere is involved; the general conditions of the air as to temperature, moisture, pressure and wind in distant regions affect this Asiatic whirl and it itself affects other distant regions. The monsoon rains of India depend on the intensity of the winds, the moisture of the air and the exact direction in which and date on which it moves over the country. It may, therefore, be said to depend mainly on the distribution of atmospheric pressure over an immense area, perhaps one third of the surface of the globe. But it may also depend ultimately on the intensity and quality of the radiation that we received from the sun, since that may exaggerate the difference of temperature over land and water or over equatorial and polar regions and thus cause slight deflections in the general currents of air. A relatively small disturbing cause may cause a deflection that will turn the southwest monsoon aside and cause it to pass by or over India or fall short of reaching it and thus cause a failure of the monsoon rains and of the crops that depend on them.

On the Construction of Isobaric Charts for Upper Levels and their Dynamic Importance in Dynamic Meteorology: Dr. J. W. SANDSTRÖM, of Stockholm. (Presented by Professor Abbe.)

Dr. J. W. Sandström, of Stockholm, has long been a student of the atmosphere under the guidance of Professor Victor Bjerknes, of Stockholm, Sweden, and his eminent father the late Professor C. A. Bjerknes, of Christiania, Norway. These mathematicians have developed Kelvin's theorem of circulation within a fluid mass and have shown how to apply it to the earth's atmosphere, provided we have accurate values of the temperatures and pressures at various altitudes. To their work Dr. Sandström now adds an important practical consideration, *i. e.*, that the study of the motions of the upper atmosphere can best be made by drawing isobars and isotherms on successive level surfaces of equal gravity rather than on surfaces of equal height above mean sea level, as has hitherto been customary. In his memoir 'On the Construction of Isobaric Charts for Upper Levels and their Dynamic Importance in Dynamic Meteorology' Sandström gives formulæ and tables for this method of study and shows its advantages. It affords a peculiarly powerful method of utilizing the observations made at the seventeen kite stations occupied by the U. S. Weather Bureau in 1898, and his illustrative computations refer especially to these observations, as they were the first ever made that spread over so large area of country as to make it worth while to develop a method that is peculiarly suitable to them. At present this method also finds its most important application in studying the international aerial work now carried on by simultaneous ascensions to great heights once or twice monthly in Europe at fourteen balloon stations, seven kite stations, combined with twenty-five mountain-top stations and thirty-five or forty cloud or nephoscope stations. In this work the only American station at present contributing is the Blue Hill Observatory, but it is hoped that the U. S. Weather Bureau will eventually join in the great undertaking.

On the Straight-line Concept: Professor F. A. LAMBERT, of Bethlehem, Pa.

Precision is given to the straight-line concept not by experience or experiment, but by assumptions or axioms. These assumptions determine whether the straight line is that of the space of Euclid, of Lobatschefski or of Riemann. Cayley's theory of measurement causes much of the apparent mystery of these three spaces to vanish.

The geometry of Euclid does not require the straight line to be continuous.

At the annual election, which occurred at 12:30 o'clock, the following persons were chosen members:

RESIDENTS OF THE UNITED STATES.

Joseph S. Ames, Ph.D., Baltimore. Professor of physics in Johns Hopkins University; honorary member of the Royal Institution of Great Britain; member of the French Physical Society; author of 'Theory of Physics,' 'Manual of Experimental Physics,' 'Elements of Physics,' 'The Free Expansion of Gases,' 'Prismatic Diffractive Spectra,' 'Induction of Electric Currents'; assistant editor of *Astrophysical Journal* and associate editor of *American Journal of Science.*

Thomas Chrowder Chamberlin, Ph.D., LL.D., Chicago. Head professor of geology in University of Chicago; president of University of Wisconsin, 1887–92; in charge of glacial division of U. S. Geological Survey since 1882; geologist of Peary Relief Expedition, 1894; member of National Academy of Sciences; editor of *Journal of Geology;* author of 'Geology of Wisconsin,' 'Text-book of Geology,' etc., and of numerous papers relating to geology.

William Gilson Farlow, Cambridge. Professor of cryptogamic botany in Harvard University; author of 'Marine Algae of New England,' 'The Black Knot,' 'The Gymnosporangia of the United States,' 'The Potato Rot,' 'Index of Fungi,' 'Diseases of the Orange and Olive Trees,' etc., etc.; late president of the American Association for the Advancement of Science; member of the National Academy of Science and of the American Academy of Arts and Sciences.

Charles H. Frazier, M.D., Philadelphia. Dean of the medical department of the University of Pennsylvania and assistant professor of surgery; editor of the *University Medical Journal* and author of numerous monographs on surgical subjects.

David Starr Jordan, Stanford University, Cal. President of Leland Stanford University; author of 'Manual of Vertebrate Animals of Northern United States,' 'Fishes of North and Middle America,' 'Footnotes to Evolution,' 'Animal Forms,' 'Food and Game Fishes of North America,' 'A Guide to the Study of Fishes,' and numerous papers on ichthyology in proceedings of various societies and government bureaus; president of the California Academy of Sciences, 1896–98.

George Lyman Kittridge, LL.D., Cambridge. Professor of English in Harvard University; member of the American Philological Association and of the American Antiquarian Society and fellow of the American Academy of Arts and Sciences; has made valuable contributions to the study of Chaucer; author in collaboration with Professor Greenough of 'Words and Their Ways in English Speech,' and of numerous contributions to technical periodicals.

Robert G. Le Conte, M.D., Philadelphia. Surgeon to the Pennsylvania Hospital; adjunct professor of surgery and trustee of the University of Pennsylvania; late surgeon-general of the National Guard of Pennsylvania; author of a number of valuable contributions to surgical literature.

Eliakim Hastings Moore, Chicago. Head professor of mathematics at University of Chicago; president of the American Mathematical Society; associate fellow of the American Academy of Arts and Sciences; member of the National Academy of Sciences; editor of the *Transactions of the American Mathematical Society;* author of valuable contributions to mathematical science.

George T. Moore, Ph.D., Washington. Pathologist and algologist in charge of Laboratory of plant physiology, Bureau of Plant Industry, U. S. Department of Agriculture; author of papers on 'Soil Inoculation for Legumes,' 'A Method of Destroying or Preventing the Growth of Algae and Certain Pathogenic Bacteria in Water Supplies,' 'New or Little-known Unicellular Algae,' etc.

Richard A. F. Penrose, Jr., Ph.D., Philadelphia. Geologist and mining engineer; geologist in charge of survey of eastern Texas for Texas Geological Survey. Professor of economic geology, University of Chicago, 1892; special geologist, U. S. Geological Survey, 1894, to examine gold districts of Cripple Creek, Col.; fellow of Geological Society of America; member of Institute of Mining Engineers; National Geographical Society, etc.; author of numerous papers on economic geology.

Francis P. Venable, Ph.D., LL.D., Chapel Hill, N. C. President of the University of North Carolina; co-author of 'Inorganic Chemistry according to Periodic Law'; author of 'Development of Periodic Law' and of a 'Short History of Chemistry' and of numerous papers on inorganic chemistry; member of American Chemical Society, German Chemical Society; fellow of London Chemical Society.

J. Edward Whitfield, Philadelphia. Chemist, analytical and engineering; from 1880 to 1889 was connected with the U. S. Geological Survey as mineralogical chemist; author of analyses of

ores and of Western Coals for Northern Transcontinental Survey, published in Tenth U. S. Census, and of numerous articles in the *American Chemical Journal, American Journal of Science* and *Journal of American Chemical Society.*

Bailey Willis, E.M., C.E., Washington. Geologist; in charge of the stratigraphic geology department of the U. S. Geological Survey, and is specially charged with the preparation of a geological map of the United States; in 1903–04 he journeyed through Siberia and China under the auspices of the Carnegie Institution to study the geological history of those countries in comparison with that of North America, and is about to extend his studies of mountain growth, etc., to some of the European ranges.

FOREIGN RESIDENTS.

Yves Delage, Paris. Professor of zoology and comparative anatomy at the Sorbonne; editor of *L'Année Biologique;* author of 'La Structure du Protoplasme et les Théories sur l'Hérédité,' Paris, 1895, and of numerous contributions to biology; member of the Institute of France.

Otto Nordenskjold, Stockholm. Eminent geographer and geologist; commanded Swedish Scientific Expedition to West Antarctica in 1901–1903; explored south and east coasts of Palmer Land, Danco Land and King Oscar Land, and has made numerous valuable contributions to knowledge in geography, geology, paleontology and meteorology. Author of 'Antarctic, två år bland Sydpolens isar,' published at Stockholm, and of many papers in the *Geographical Journal, La Geographie* and other scientific publications.

William Matthew Flinders Petrie, D.C.L., LL.D., F.R.S., London. Professor of Egyptology in University College, London; has made extensive excavations in Egypt and numerous important contributions to Egyptian archeology; author of 'Pyramids and Temples of Gizeh (1883), 'Tanis' (2 vols., 1888–89), 'Naukratis' (1886), 'History of Egypt' (1894–96), 'Abydos' (2 vols., 1901–02), etc.

Edward Sievers, Leipzig. Professor of the German language and literature in the University of Leipzig; an eminent authority in phonetics, text criticism and meters; author of 'Angelsachsische Grammatik,' 'Phonetik,' 'Altgermanische Metrik,' and of many other monographs.

Sir William Turner Thiselton-Dyer, LL.D., Ph.D., F.R.S., Kew, England. Eminent botanist; director of Royal Botanic Gardens; botanical adviser to the Secretary of State for the Colonies, and has contributed very largely to the development of the botanico-economic resources of the British Empire; editor of 'Flora Capensis' and of 'Flora of Tropical Africa.'

Afternoon Session—2:30 O'clock.

President Smith in the chair.

The Theory of the Double Suspension Pendulum: Professor R. S. WOODWARD.

The double suspension pendulum is an apparatus for determining the acceleration of gravity. It consists of a massive rectangular bar, which is held rigidly and horizontally, and from which is suspended a similar bar by means of two parallel steel tapes of equal length. These tapes pass through the bars and are clamped rigidly to them. The tapes may thus be regarded as elastic beams built in at both ends. The suspended bar vibrates longitudinally by reason of its weight and by reason of the elastic bending of the tapes. Measurements with the apparatus require observations of the time of vibration of the suspended bar and the lengths of the suspending tapes. This form of pendulum avoids entirely the difficulties of the knife edges of ordinary pendulums and has the additional advantage of superior steadiness arising from the large vibrating mass. The paper outlines the mathematical theory of the motions of such a pendulum.

The Relation Between the Economic Depth for Bridge Truss and the Depth which Gives Greatest Stiffness: Professor MANSFIELD MERRIMAN, of Bethlehem, Pa.

The paper was read by the author. He explained that the increase in the depth of bridge trusses which has been going on for the past fifty years was due to considerations of economy and showed that there is a certain depth which gives the minimum amount of material. With respect to deflection under the passage of a train, it has generally been supposed that this continually decreased as the depth of the truss increased, but the author presented a proof

that this is not the case. The deflection decreases with increase in depth up to a certain point and beyond that it increases. The computations of Professor Merriman indicate that the depth of truss which gives the least deflection or the greatest stiffness is a little less than the economic depth. He also showed that the relation between the economic depth and the span of the bridge applies very closely to the depth which gives the greatest stiffness.

On the Dispersion, Absorption, Fluorescence and Magnetic Rotation of Sodium Vapor: Professor Robert Williams Wood, of Baltimore.

A Photographic Study of the Diffusion of Ultra-Violet Light by Gas Particles: Professor Robert Williams Wood, of Baltimore.

On the Use of the Falling Plate Oscillograph as a Phasemeter: Dr. William McClellan, of Philadelphia.

The three general methods for obtaining the form of an alternating current wave are—by means of contact-maker and meter, by means of a curve-tracer and by means of an oscillograph. With the first and second methods the current must be kept absolutely constant, as some time is necessary to take the numerous readings required to plot the curve. The oscillograph gives a picture of a single wave. Essentially it is a sensitive moving-coil mirror galvanometer, with a period of about one ten-thousandth of a second. It is able, therefore, to follow easily currents of commercial frequency. To obtain the wave form it is necessary to have a uniform motion perpendicular to the motion of the coil. This is obtained by synchronous motors, revolving films or a falling photographic plate. The latter has been found to be very convenient, though its motion is uniformly accelerated instead of uniform. The error is small, however.

With a double oscillograph, that is one that can draw two curves simultaneously, for example the current and voltage waves of a single circuit, we can immediately see the possibility of a phasemeter. To test the accuracy of the instrument when used in this way, an Ayrton and Perry standard of self-induction, of known resistance, was used. Current and electromotive force waves were obtained and the angle of lag measured. These were compared with the values calculated from the constants of the standard.

On the Brains of Scymnus, Mitsukurina and Chlamydoselachus, with Remarks upon Selachian Brains from Standpoints Morphic, Ontogenic, Taxonomic, Phylogenic and Pedagogic: Professor Burt G. Wilder, of Ithaca.

Of the three sharks named in the title all occur in Japanese waters. *Mitsukurina* (which may be called the 'rostrum shark' from the extraordinary projection of the snout separated from the upper jaw by a deep notch) was first described in 1898 by Jordan and has not, as yet, been found elsewhere; it is so remarkable, and the examples already obtained are so few that the specimen exhibited cost about $75.00 So far as the speaker is aware its brain has never before been studied. *Chlamydoselachus* is also very rare, but besides the Japanese specimens at least one has been taken off Madeira. It was described in 1884 by Garman, who suggested 'frilled shark' as a popular name, referring to the folded covers of the gill-slits, of which there are six instead of five as with most modern sharks. The body is so long and snake-like that Garman gave it the specific name *anguineus,* and perhaps a good popular title might be the English form, anguin; it has even been thought by some that

particularly large examples may have given color to the belief in the 'sea-serpent.' Garman's example was ill-preserved and the brain obviously in poor condition; the Cornell specimen is quite perfect. *Scymnus* has been long known; it is a rather ordinary-looking shark and occurs also in the Mediterranean, but it seems not to be very common, at any rate Professor Wilder has been unable to obtain a well-preserved specimen, and only recently has obtained a brain through the generosity of Professor Locy, of the Northwestern University.

Professor Wilder's special reason for studying the brain of *Scymnus* has been his wish to confirm or correct the account given in 1882 by the late T. Jeffery Parker, of New Zealand. According to this writer *Scymnus* 'exemplifies with diagrammatic clearness the typical structure of the vertebrate brain.' Professor Wilder finds that it really resembles more nearly the brain of *Heptanchus* and the earlier figures of Busch and Maclay; and this was to be expected since *Scymnus* is not, as to its other structures and its extinct relatives, such a very primitive type. But the simple conditions ascribed by Parker to *Scymnus* are more closely embodied in the anguin or frilled shark, whose cladodont relatives were in the Devonian epoch and which Garman regards 'the oldest [known] living type of vertebrate.' Here the walls of the forebrain are thinner and less differentiated, and in the lateral extensions toward the olfactory cups ('nostrils') the so-called cerebral portion expands nearly equally in every direction from the axis represented by the olfactory cruss; in most other sharks and in rays or skates the special cerebral extension is toward the meson or middle line, so as to meet the corresponding part of the other side; in the lamprey the cerebral extensions are away from the meson; in the Dipnoi, as shown by the speaker in 1887, they are downward, while in the ordinary and higher air-breathing vertebrates, reptiles, birds and mammals, the cerebral hemispheres expand mostly upward. It is as if nature had experimented in the four directions at right angles with one another from the primitive condition, nearly as in *Chlamydoselachus,* where the extension is almost uniformly in all directions from the olfactory axis. There were shown diagrams illustrating this idea, and also the possible derivation of the several grades of shark and ray brains from the hypothetic stem form, probably extinct and now inferred only from the embryonic conditions of recent forms. In this connection the speaker reiterated his previously expressed conviction that in evolution the olfactory portion of the brain had preceded the cerebral; that the ancestral vertebrates needed to smell rather than to think; that the organ of forethought had been, so to speak, an afterthought, and that the cerebral region, so preponderant in man, was rather an offshoot from the olfactory region, and had been interpolated between that and the hinder portions of the brain. The primitive preeminence of olfaction he regards as supported by the recent observations of Locy and others upon a nerve in most (probably all) sharks and rays and in some other generalized forms, connecting the nasal mucosa with the very front of the brain, and so slender as to have been commonly overlooked; in *Mitsukurina,* where the olfactory crura are extremely long, the nerve has been most skillfully worked out by Locy, to whom the Cornell brain was sent for the purpose. Although, from its late discovery, sometimes called the 'new nerve,' Professor Wilder thinks, perhaps, it is the very oldest; as suggested by Locy, its functions have been replaced by others,

and it has become vistigial in the generalized vertebrates, having disappeared altogether in the higher. The speaker commended Locy's paper as a model research, displaying the 'five Cs,' clear, consistent, correct, concise and, so far as possible, complete.

Professor Wilder has long held that the very difficulties of neurology demand its early cultivation and that the elements of this most abstruse natural science, like those of astronomy, should be taught objectively in the primary schools. After trying various forms he concludes that the required pedagogic conditions are best met by the sharks and rays, particularly in respect to the ease with which they may now be had from the supply departments of the numerous marine laboratories; he believed it especially desirable that the beginner should himself lay bare the specimen so as to feel toward it an actual sense of ownership like that of a discoverer. Since the skulls of these fish are of cartilage, the brain can be exposed with the simplest instruments, even a jack-knife, better a small shoe-knife cut off obliquely.

In concluding Professor Wilder declared that the greatest mistake of his scientific life occurred while working on these sharks and rays in 1866–68 for the late Professor Louis Agassiz; he persisted in devoting himself to less noble and significant structures, notwithstanding the gently expressed preference of his too considerate employer. Since 1873 he has lost no opportunity of preparing and dissecting selachian brains, and hopes the present paper may arouse interest in them and lead to the recognition and elucidation of the numerous and complex problems connected with them.

The final event of this most successful meeting was a dinner at the Bellevue-Stratford on Friday evening. On this occasion Professor Edgar F. Smith, president of the society, acted as toastmaster. Addresses were made by President Smith; Dr. Woodrow Wilson, president of Princeton University, who responded to the toast 'The Memory of Franklin'; Dr. Woodward, president of the Carnegie Institution; Dr. H. W. Wiley, of Washington; Professor W. B. Scott, of Princeton, and Professor W. T. Hewett, of Cornell.

SCIENTIFIC BOOKS.

The Whalebone Whales of the Western North Atlantic, compared with those occurring in European Waters, with some observations on the species of the North Pacific. By Frederick W. True. City of Washington, published by the Smithsonian Institution. 1904. Pp. viii + 332; 97 text figures; 50 plates.

Those who are acquainted with the imperfect condition of our knowledge of whales, and particularly of the larger species, with the consequent multiplication of species and genera, will appreciate this memoir as well as realize the labor involved in its preparation. The objects of the work are to definitely decide the specific identity or difference of the species of whales occurring on the coast of Europe and America and to locate and identify the specimens on which the American species were based. These problems proved to be so involved that the subject of the distribution and migrations of the larger cetacea, which first led Mr. True to study the whales, had to be postponed.

That the synonymy of the larger cetacea should be involved is not surprising; owing to the practical impossibility of systematically collecting such animals, the greater part of the species are founded upon specimens, often fragmentary, that have accidentally come to hand, with the result that observations have been desultory and disconnected.

The first chapter of Dr. True's memoir is devoted to 'The Earliest References to Whalebone Whales in American Waters,' and this is full of information and interest to both naturalist and general reader, since it con-